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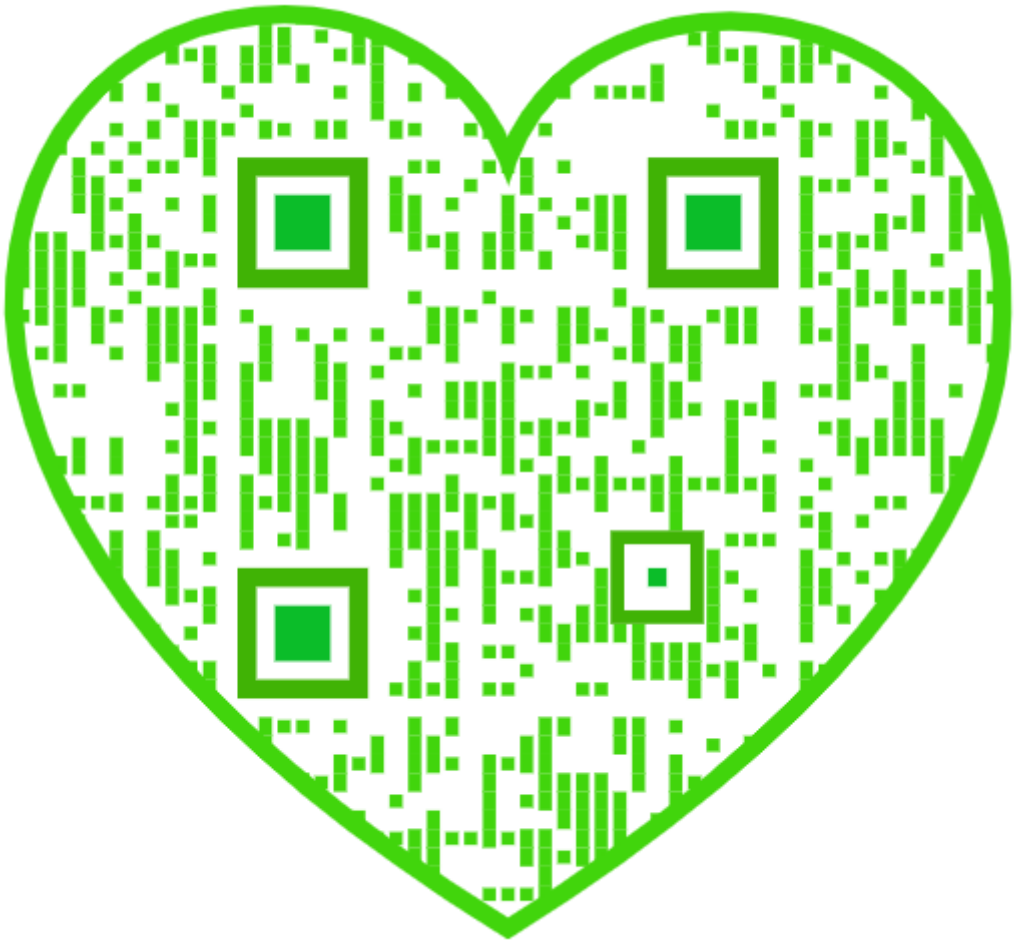

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USE OF INTERFERENTIAL CURRENTS IN COMBINED ANAESTHESIA IN SURGERY

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ABSTRACT

The authors describe the method of combined electroanaesthesia with interferential currents in 24 cases of various surgical operations. To choose the correct current for electroanaesthesia (minimal interferential currents bringing light anaesthesia) analgesia was tested before the operation. When interferential currents are used for electroanaesthesia the shortcomings of the method clinically are eliminated. author

Electroanaesthesia, which was first used by Leduc in 1902, has recently capured the attention of researchers again due to its definite advantages (the almost instantaneous introduction of analgesia in the patient, and the bringing out from electroanaesthesia, the great therapeutic value, the absence of side effects and after-effects on the body). /57*

For a short time after the research by Leduc, electroanaesthesia was studied experimentally, and individual attempts were made to employ it in

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* Note: Numbers in the margin indicate pagination in the original foreign text.

surgery (Robinovitsch, Neergard; G. S. Kalendarov; V. A. Glazov; Bonino, Ballestrazzi; N. M. Liventsev; M. G. Anan'yev; Smith). All of these authors employed a square wave current (up to 8 mA as a mean value, off-duty factor 1:10) in conjunction with a galvanic component (up to 16 mA as a mean value), or a sinusoidal current (up to 220 mA as an effective value, with a frequency of 700 cps, as a rule).

Kirschbaum successfully applied electroanaesthesia in operations on eight patients with burns on 20-60% of the entire body surface. The current reached 180-200 mA in the first minute of anaesthesia; it then decreased to 100-110 mA. After the operation was terminated, the current strength decreased to zero in 15 minutes. All eight patients were unconscious during the operation, and consciousness rapidly returned after the current was switched off. The authors proposed electroanaesthesia as a method of selection during operations on burned patients with clearly expressed toxemia.

However, along with the analgesia, the electric current produced general muscular rigidity, breathing difficulty due to laryngospasm and impairment of the respiratory muscle function, a considerable increase in the arterial pressure, tachycardia, and clearly expressed unfavorable sensations under the electrodes at the beginning of the anaesthesia.

Previously, when very deep anaesthesia and relaxation of the muscles /58 were desired when each anaesthesia method was employed, electroanaesthesia could not compete with other narcotic methods. In recent years, general anaesthesia has undergone significant changes and has come to contain several components. Individual pharmacological methods have been employed in order to produce analgesia; others have been employed to supplement it by relaxation of all the skeletal muscles. Thirdly, other methods have been employed

to control the hemodynamics.

At this new developmental stage of total anaesthesia, attempts have been made to utilize electroanaesthesia to sustain analgesia in multicomponent anaesthesia with the use of muscle relaxants and ganglio-blocking preparations (Lombard, Knutson).

Hardy was the first to conduct twelve operations lasting up to two and one-half hours under electroanaesthesia. The author employed a sinusoidal current with a frequency of 70 cps. The current strength varied between 45-110 mA. The premedication was secobarbitol (75-100 mg) and atropine (0.8 mg). After thiamyl (200 mg) and succinyl-choline (50 mg) were introduced, intubation was performed; then the current strength increased up to the optimum value for maintaining analgesia. After the operation was terminated, extubation was performed and the current was switched off. The narcotic influence of the latter ended instantaneously. However, when this method was employed a clearly-expressed (up to 140 strokes per minute) tachycardia and arterial hypertension (up to 260 mm) were observed during the operation. The patients evaluated the current as unpleasant. Two out of the twelve patients did not undergo complete anaesthesia, which was probably related to the incorrect selection of the requisite current strength. A complication arose in one patient - a class I burn under the electrodes. The ECG and EEG, recorded before and after the narcosis, indicated no changes which could be related to the prolonged influence of the current during the electroanaesthesia. Biochemical studies performed on five patients showed an increase in the level of catecholamines and 17-hydroxy corticosteroids, and an increase in the blood pH during the operation.

Thus, even in combination with generally accepted components,

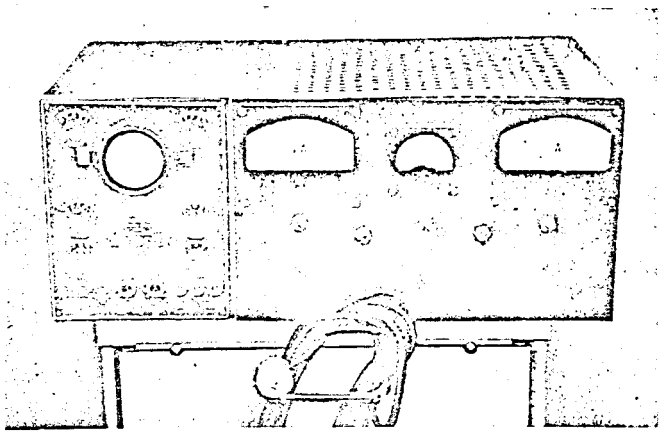
electroanaesthesia with a sinusoidal current does not satisfy the requirements for total anaesthesia.

New modifications of the currents have recently been advanced. These modifications make it possible to eliminate the accompanying negative effects, retaining the narcotic effect on the central nervous system. One of these modifications is the interference currents (Nemec). By combining two currents of similar frequency which are slightly sensitive for sublimis structures (the skin, the periosteum) which are rich in neural formations, one can use the interference method to produce low frequency current oscillations which are necessary for electroanaesthesia in the deeper object being affected. With interference, the amplitude of the resulting oscillation in the object being affected is considerably greater than the current amplitude of the interference frequency. Thus, by influencing the subliminal by the current strength, one can produce the supraliminal in deep objects being influenced, which represent formations of the brain stem.

Acting upon the suggestion of N. M. Livenpsev, we attempted to pursue the possibility of employing interference currents for anaesthesia during operations. In this connection, a special ICG-2 (interference current generator) was constructed jointly with the physical-technical department of the TsNIIK and F* (M. A. Ravich). This apparatus made it possible to produce interference currents of narcotic parameters (see the figure).

Before testing the apparatus, 20 combined electroanaesthesias (induced anaesthesia, 25-50 mg Pentothal sodium) were performed in the clinic (V. D. Zhukovskiy), with the use of muscle relaxants (0.2 mg lystenone per 1 kg of weight) and of controlled breathing on dogs. We recorded breathing,

* Translator's note: This may refer to Central Scientific Research Institute of Cardiology and Physiology.



General View of the Apparatus

pulse, arterial and venous pressure, rectal temperature, and the ECG before and after the experiment. A portion of the anaesthesias was combined with operations on the pectoral and abdominal cavity and the extremeties. The results obtained enabled us to proceed to clinical research.

A correct selection of the narcotic current strength is requisite for performing successful, combined electroanaesthesia. No such criteria are given in the literature. As one approach toward solving this problem, on the day before the operation the minimum current strength was determined which produced surface analgesia (without other side effects which would disturb the patient). This "test" was performed on 30 patients. The threshold of surface analgesia varied from 2.5 to 12 mA for these patients, and - as a rule - it was higher in men than in women. It was particularly /59 high in men who consumed a large amount of alcohol.

Twenty-six combined electroanaesthesias were performed in the clinic by interference currents during different surgical operations: Mastectomy, diagnostic laparotomy with examination of the abdominal cavity, examination

of the small intestine, herniotomy, appendectomy, and removal of varicose veins.

Pre-medication - 0.5 mg atropine and 20 mg promedole - was given for 30 minutes before the operation. 25 mg aminazine were added for seven patients with a particularly labile nervous system. After induced narcosis by hexenal (250-300 mg) and the use of muscle relaxants (80-100 mg lystenone), intubation was performed with subsequent controlled breathing throughout the entire operation. The current strength was increased up to half of that calculated the day before (30-50 mA). At the beginning of the operation, the current strength was adjusted to 60-100 mA. The electrodes were located on the occiput.

During the narcosis and the operation, after an increase - which was caused by the intubation and which is usually observed in every narcosis - the arterial pressure gradually returned to the initial value, exceeding it by 8 mm. The pulse frequency, which increased by 16 strokes per minute synchronously with an arterial pressure increase, then decreased and remained fairly stable until the end of the operation. After an increase by 22 mm water column at the beginning of narcosis, the venous pressure decreased parallel with the arterial pressure (P 0.03).

For 24 out of the 26 patients operated upon, the anaesthesia was complete, and the patients did not react even during the most traumatic moments of the operation. Due to the incorrect selection of the current strength at the beginning of our work, the anaesthesia was incomplete for two patients. For these patients the arterial pressure increased (by 35-40 mm), and did not decrease until the end of the operation. The pulse frequency increased periodically up to 120-140 strokes per minute; the pupils dilated in separate stages

of the operation.

In addition to muscle relaxants, Hardy and Turner were forced to introduce thiamyl periodically during the operations under combined electroanaesthesia, in order to reduce the tachycardia and to lower the arterial pressure to the original values. There is no necessity of doing this when interference currents are employed, since the pulse frequency and arterial pressure are stable and remain at a level close to the initial level when the current strength is correctly selected.

It was possible to talk with the patient immediately after extubation. /60 The patients were not aware of the current during the operation. The feeling of pinching under the electrodes - which was one of the significant drawbacks of electroanaesthesia by sinusoidal and impulse currents - was completely lacking. A slight tactile sensitivity was retained in eleven patients; they could describe their environment during the operation in detail.[1] The remaining patients could not recall anything which occurred during the operation, which indicates that the current doses employed were on the threshold of breaking contact with consciousness. It must thus be assumed that the anaesthesia for these patients occurred at the 2-3 rd level of the I stage. The muscle relaxant doses which were introduced during the operation did not exceed the usual amount.

In the post-operative period, two patients experienced muscle pains, which were observed with the use of depolarization muscle relaxants and when

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[1] It is apparent that there was no narcosis in these patients. This must be regarded as one drawback of this method. -The Editor.

they were combined with other types of anaesthesia. One patient complained of head pains for two days after the operation. No other complications were observed.

Conclusions

1. Interference currents can play a definite role in present day multi-component anaesthesia.

2. Combined electroanaesthesia by interference currents has an indisputable advantage over electroanaesthesia methods employed previously.

3. The method of combined electroanaesthesia by interference currents is simple and safe; therefore, future research on its use in a surgical clinic is requisite.

REFERENCES

1. Anan'yev, M. G. et al. In the book: New Surgical Apparatus and Instruments and Experience with Their Use (Novyye khirurgicheskiye apparaty i instrumenty i opyt ikh primeneniya). Moscow, p. 137, 1957.
2. Glazov, V. A. Catatonia (Katatoniya). Doctor's Dissertation, Leningrad, 1940.
3. Kalendarov, G. S. Electric Narcosis (Elektricheskiy narkoz). Moscow, 1937.
4. Liventsev, N. M. A Study of Certain Reactions of the Body Under the Influence of an Impulse Current on the Central Nervous System (Izucheniye nekotorykh reaktsiy organizma pri deystvii impul'snym tokom na tsentral'-nuyu nervnuyu sistemu). Doctor's Dissertation, Moscow, 1952.
5. Ballestrazzi, N. Nevrasse, Vol. 5, p. 135, 1955.
6. Hardy, J., Fabian, L. W. J.A.M.A., Vol. 175, p. 599, 1961.
7. Fabian, L. W., Hardy, J. D. et al. Anesth. Curr. Res., Vol. 40, p. 653, 1961.

8. Kirschbaum, S. et al. Pren. Med. Argent., Vol. 41, p. 3368, 1954.

9. Knutson, R. C., Tichy, F. Y., Reitman, J. H. Anesthesiology, Vol. 17, p. 815, 1956.

10. Leduc, S. Presse Méd., Vol. 15, p. 129, 1907.

11. Lombard, W. A., Denyssen, J., Owens, W. S. Afr. Med. J., Vol. 27, p. 45, 1953.

12. Neergard, K. Arch. Klin. Chir., Vol. 122, p. 100, 1925.

13. Nemec, H. Electromedizin, Vol. 3, p. 232, 1958.

14. Robinovitsch, L. J. Ment. Path., Vol. 8, p. 97, 1909-1910.

15. Smith, R. H. et al. Anesthesiology, Vol. 23, p. 682, 1962.

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